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PRELIMINARY WASTEWATER ASSESSMENT
INGHAMS SITE, TAHMOOR

FOR

INGHAM PROPERTY DEVELOPMENT PTY LIMITED

PROJECT NO. 18661/2001C **SEPTEMBER 2012**
REPORT NO. 12/1154

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DRAWING NO. 12/1154 : BOREHOLE LOCATIONS

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1. INTRODUCTION

This report presents the results of a preliminary wastewater assessment undertaken by SMEC Testing Services Pty Limited (STS) for a proposed new subdivision at Inghams Site, Tahmoor. We have been informed the proposed dwellings will likely accommodate up to 6 residents and are proposed to be supplied by town water.

The purpose of the investigation was to:

- determine the subsurface conditions across the site,
- undertake field and laboratory testing and based on the data collected, assess the capability of the site soils to accept effluent, and
- determine the range of areas required to using both surface and subsurface irrigation systems.

The study was undertaken at the request of Michael Parkinson of Ingham Property Development Pty Limited.

The wastewater assessment has been made using the following publications:

Reference 1: AS/NZS 1547:2012, "On-site domestic wastewater management" Standards Australia.

Reference 2: Department of Local Government (1998), "On-site Sewerage Management for Single Households," Environment and Health Protection Guidelines.

2. SITE LOCATION AND DESCRIPTION

The site, located to the south of the East Tahmoor lands, comprises of approximately 166.45 hectares that is currently zoned RU4 *Rural Small Holding* under the Wollondilly Local Environmental Plan 2011. This site currently comprises a series of large contiguous rural lots, and occupies an existing duck farm operation. The remainder of the land is used for general grazing. Further, it is noted that the *Picton Tahmoor Thirlmere New Urban Lands Planning Proposal* seeks to rezone a portion of land in East Tahmoor (to the north of the Ingham's site) from RU4 Rural Small Holdings to R2 Low Density Residential. The Inghams Planning Proposal compliments the current proposed rezoning to the north of the site, albeit offering a unique and larger form of future residential subdivision on the periphery of the existing township of Tahmoor.

Rainfall data used to prepare the wastewater management plan for the site is that recorded by the Australian Government Bureau of Meteorology at Picton Council Depot and evaporation at Badgerys Creek (1967-1984). Details are given in Appendix A.

TABLE 1: MONTHLY RAINFALL AND EVAPORATION

MONTH	RAINFALL (Median) (mm)	AVERAGE EVAPORATION (mm)
January	65.5	182.9
February	70.6	151.2
March	68.3	139.5
April	47.3	105.0
May	31.8	65.1
June	40.2	51.0
July	26.1	65.1
August	25.2	93.0
September	37.4	120.0
October	49.6	145.7
November	55.6	171.0
December	55.1	124.6

3. GEOLOGY

The Wollongong – Port Hacking geological series sheet, at a scale of 1:100,000 indicates that the site is underlain by a combination of Triassic Age Hawkesbury Sandstone to the east and Triassic Age Ashfield Shale of the Wianamatta Group to the west. Rocks within the Hawkesbury Sandstone formation typically consist of medium to quartz grained sandstone with minor shale and laminite lenses. Rocks within Ashfield Shale formation comprise shale, claystone and laminite.

Rocks within these geological formations typically weather to form silty clays and sandy clay soils.

4. NATURE OF INVESTIGATION

4.1 Fieldwork

For the assessment, the fieldwork consisted of drilling eleven boreholes, numbered BH1 to BH11, at the locations shown on Drawing No. 12/1154. The boreholes were drilled using an Edson RP70 drilling rig owned and operated by STS. All fieldwork was carried out by one of STS's experienced senior engineering geologists who obtained representative samples for laboratory testing purposes.

The subsurface conditions observed are as shown on the borehole logs given in Appendix B. A description of the terms used on the borehole logs is also given. Notes relating to geotechnical reports are also attached.

4.2 Laboratory Testing

In order to undertake the assessment certain physical and chemical properties of the on-site soils were determined. The physical testing was undertaken in STS's laboratory and the chemical testing was undertaken at Australian Laboratory Services (ALS). The following testing was carried out on the soil samples.

- Particle size distribution,
- Emerson Crumb tests,
- pH and electrical conductivity,
- Cation exchange capacity (CEC), and
- Exchangeable sodium potential (ESP).
- Phosphorous sorption index.

Detailed laboratory test results are given in Appendix C.

5. SUBSURFACE CONDITIONS

When making an assessment of the subsurface conditions across a site from a limited number of boreholes, there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. The actual condition at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The subsurface materials comprise topsoil overlying silty clays and weathered shale / sandstone. A thin lens of fill was encountered in BH9. The clays overlying the bedrock are firm to very stiff materials.

No groundwater was observed in the boreholes during the fieldwork.

6. LABORATORY TEST RESULTS

The physical soil parameters are summarised in Table 2 and the chemical parameters in Table 3.

TABLE 2: PHYSICAL SOIL PROPERTIES

Location	Depth (m)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Emerson Class No.	Material Description[1]
BH1	0.0 - 0.5	30	18	20	32	5	Silty Clay Loam
BH2	0.0 - 0.4	46	21	19	14	5	Clay
BH3	0.0 - 0.4	37	25	16	22	5	Silty Clay Loam
BH4	0.0 - 0.5	52	25	13	10	5	Silty Clay
BH5	0.0 - 0.4	18	9	33	40	5	Sandy Loam
BH6	0.0 - 0.4	12	8	40	40	5	Sandy Loam
BH7	0.0 - 0.4	15	10	25	50	5	Sandy Loam
BH8	0.0 - 0.4	17	8	32	43	5	Sandy Loam
BH9	0.0 - 0.4	33	12	27	28	5	Clay Loam
BH10	0.0 - 0.4	30	12	23	35	5	Clay Loam
BH11	0.0 - 0.4	26	10	24	40	5	Clay Loam

[1] = As given in AS/NZS 1547:2012

TABLE 3: SOIL CHEMICAL PROPERTIES

Location	Depth (m)	pH	Electrical Conductivity (µS/cm)	CEC (meq/100g)	ESP (%)
BH1	0.0 – 0.2	7.0	56	11.6	0.6
BH2	0.0 – 0.2	7.0	43	5.2	3.0
BH3	0.0 – 0.4	6.9	39	6.6	9.6
BH4	0.0 – 0.4	6.7	38	2.2	8.2
BH5	0.0 – 0.2	7.1	79	6.6	0.4
BH6	0.0 – 0.4	6.5	57	3.1	1.0
BH7	0.0 – 0.2	6.6	21	4.0	1.0
BH8	0.0 – 0.2	7.2	60	8.3	0.2
BH9	0.0 – 0.2	6.8	32	5.6	0.5
BH10	0.0 – 0.4	6.7	29	4.8	2.7
BH11	0.0 – 0.2	6.6	47	8.5	0.6

Based on the results in Table 2, a maximum and minimum Design Irrigation Rate (DIR) has been determined using Table M1 in AS/NZ1547:2012. The DIR value has been determined using a factor of safety of 1.5 for a spray irrigation system. The values are as follows:

Minimum: (BH2): 14.0mm/week

Maximum: (BH7): 23.3mm/week

7. WASTEWATER ASSESSMENT

7.1 Soil Constraints

Individual soil features are discussed below and a limitation rating is provided for each feature.

- Depth of soil - greater than the 0.4 m minimum required.
- Depth to watertable – non encountered.
- Soil permeability – DIR values of 35mm/week are consistent with a soil of good permeability. However DIR values of 14mm/week are consistent with a soil of low permeability which may pose a moderate limitation resulting in excessive run-off, water-logging and lack of percolation.
- pH – Minimum and maximum vales of 6.5 and 7.2 pose a minor limitation whereby a low pH could inhibit plant growth, however this is not considered a particularly low number and vegetation has been observed on the site, therefore these pH levels should pose no constraint.
- Electrical conductivity – this is a measure of soil salinity. Values below 4dS/m (4000μS/cm) pose no constraints. The measured values are less than this value.
- Sodicity. Exchangeable sodium percentage (ESP) is a measure of sodicity. Values less than 5 are considered non-sodic, whilst values greater than 10 are considered highly sodic. Values of 0.2 to 9.6 indicate generally non sodic with slightly sodic soils encountered in BH3 and BH4 only.
- Cation Exchange Capacity (CEC). A measure of the soil's ability to retain nutrients. Values in excess of 15 meq/100g pose no constraints. The measured values of 2.2 to 11.6 are less than 15 and therefore pose a moderate limitation.

The above assessment indicates there are no major constraints based on the soil properties.

7.2 Site Constraints

Individual site features are discussed below and a limitation rating provided for each:

- Flood potential - The site is above the 1 in 100 year flood contour.
- Exposure - The proposed disposal areas have good wind and sun exposure.
- Slope - The slopes on the site are less than 10 degrees. Ensuring a good grass cover is maintained in the spray areas should ensure minimal if any erosion.
- Run on and up slope drainage - Where this is excessive, wastewater can be transported off site.
- Erosion potential - None visible on the site.
- Site drainage - No sign of surface dampness.
- Rock outcrops - None present on the site.
- Fill – Fill only encountered in one area and only to 100mm below surface.
- Geology - There are no geological discontinuities in the area.
- Buffer distances - The following should be adopted.

System	Recommended Buffer Distances
All land application systems	• 100 metres to permanent surface waters (eg river, streams, lakes, etc) • 250 metres to domestic groundwater well • 40 metres to other waters (eg farm dams, intermittent waterways and drainage channels, etc)
Surface spray	• 6 metres if area up-gradient and 3 metres if area down-gradient of driveways and property boundaries

irrigation	• 15 metres to dwellings • 3 metres to paths and walkways
Subsurface irrigation	• 6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings.

8. WASTEWATER MANAGEMENT

The following assessment has been undertaken based on a worst case and best case scenario, i.e. for each particular assessment criteria we have presented the maximum and minimum disposal area based on the results of the site and laboratory testing.

8.1 Required Irrigation Area

The design criteria for sizing the required wastewater irrigation area for a household are detailed in AS 1547. The required area for spray irrigation is calculated as follows:

$$A_i = q_w/DIR$$

Where

A_i = irrigation area required (m^2)
q_w = total quantity of effluent generated per week (L-litres)
DIR = design irrigation rate (litres/m^2/week)

The Australian Standard estimates a minimum design daily effluent flow of 150 litres per person per day. We have been informed that the design must allow for 6 occupants. This equates to a weekly effluent flow of 6300 L for the household.

For a minimum DIR value of 14 litres/week, the minimum surface irrigation area required is:

$$A_i = 6300/14.0 = 450\ m^2$$

For a maximum DIR value of 23.3 litres/week, the minimum surface irrigation area required is:

$A_i = 6300/23.3 = 270\ m^2$

8.2 Hydraulic Loading

The hydraulic loading provides an indication of the potential periods when wet weather storage may be required. The hydraulic loading is given by the following relationships:

Hydraulic Loading = Precipitation - (Evapo transpiration + Percolation)

The monthly hydraulic loadings for the sites are determined from the water balance given in Appendix D. Hydraulic loads in excess of zero indicate wastewater storage is required.

8.3 Nutrient Balance

The amount of nutrient available can be determined by multiplying the effluent application note by the amount of nutrient in the effluent. For an effluent rate of 900 litres per day the available nutrients are as follows:

Nitrogen = 9.9 kg/yr (Assume nominal rate of 30 mg/litre)
Phosphorous = 3.9 kg/yr (Assume nominal rate of 12 mg/litre)

In regards to the nitrogen, a nominal rate of 25 mg/m^2 /day has been assumed for the uptake of nitrogen into the soil. We have assumed that 50% of the nitrogen will be either lost to the atmosphere or taken up by the vegetation.

The area required is calculated as follows:

$$A = \frac{(0.5 \times 30) \times Q}{25} \qquad Q = \text{flow rate (L/d)}$$

This leads to an area of 540 m^2 being required for nitrogen.

The phosphorous sorption capacity of the onsite soils range between 2440 and 753 mg/kg. Assuming a bulk unit weight of 1.9 t/m^3 and a penetration depth of 400mm this equates to a maximum uptake of 1.85 kg/m^2 and minimum uptake of 0.57 kg/m^2.

The area required for a 50 year life can be determined by multiplying the life required by the available phosphorous (3.9 kg/yr).

Minimum Area required (phosphorous) $= \frac{3.9}{1.85} \times 50$

$= 105\ m^2$

Maximum Area required (phosphorous) $= \frac{3.9}{0.57} \times 50$

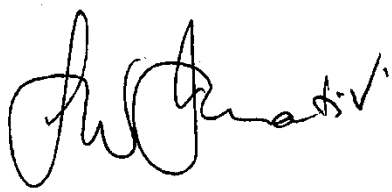
$= 342\ m^2$

8.4 Conclusion

Based on the above assessment the required area for the different criteria are as follows:

Criteria	Hydraulic	Nitrogen	Phosphorous
Minimum Area required (m^2)	300	540	105
Maximum Area required (m^2)	540	540	342

The nitrogen requirements dictate the minimum disposal area required.



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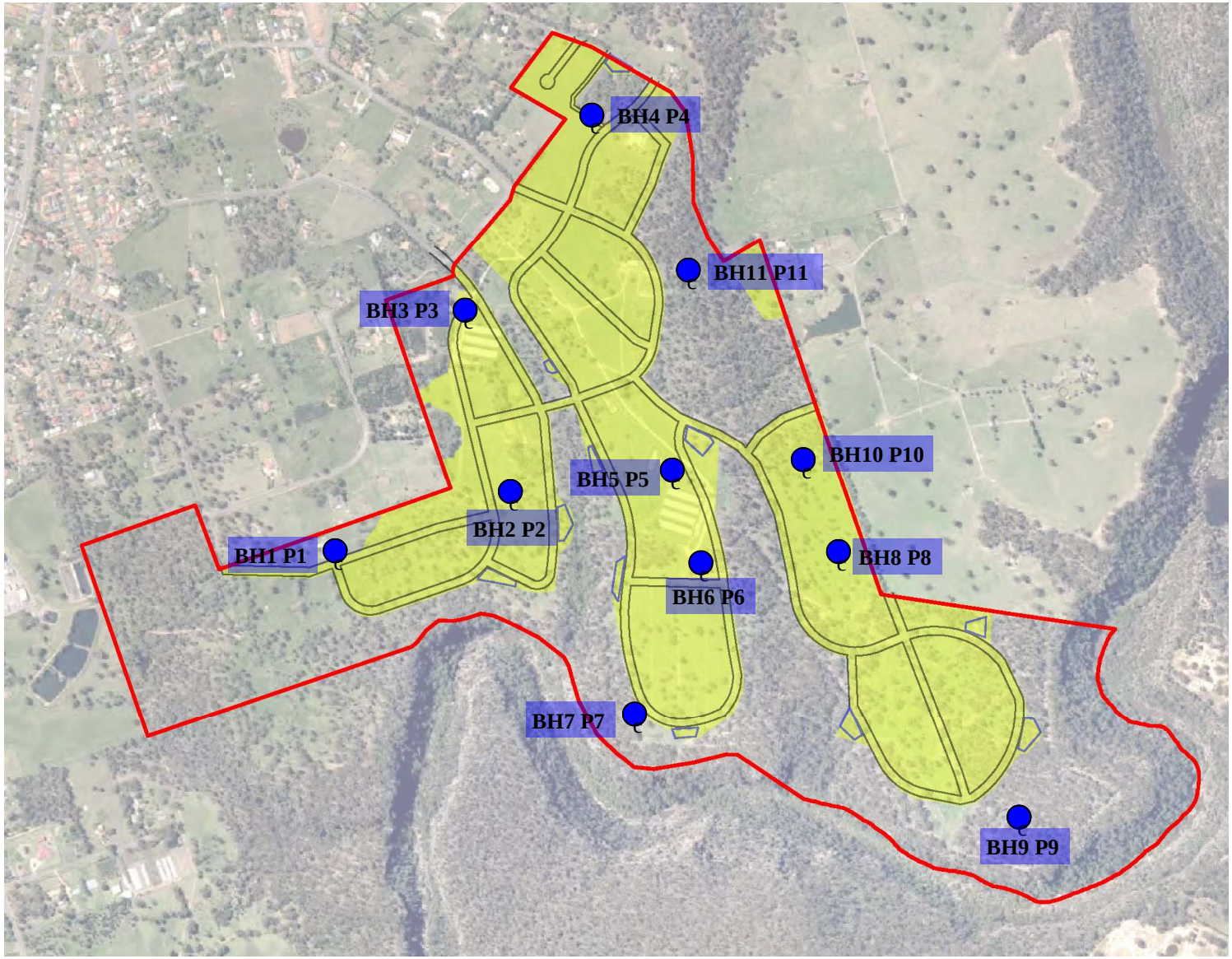


SMEC TESTING SERVICES Pty. Ltd.	Scale: Unknown	Date: AUGUST 2012
Client: INGHAMS PROPERTY DEVELOPMENT PTY LTD		
PRELIMINARY WASTEWATER ASSESSMENT **INGHAMS SITE, TAHMOOR** **BOREHOLE AND PENETROMETER LOCATIONS**	Project No. 18661/2001C	
	Drawing No: 12/1154	

NOTES RELATING TO GEOTECHNICAL REPORTS

Introduction

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC Testing Services Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, SMEC Testing Services Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC Testing Services Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information or Tendering Purposes

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A

BUREAU OF METEOROLOGY DATA

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Site name: BADGERYS CREEK MCMASTERS F.STN **Site number:** 067068 **Commenced:** 1936
Latitude: 33.87° S **Longitude:** 150.73° E **Elevation:** 65 m **Operational status:** Closed 31 Dec 1996 Map

View: Main statistics All available Period: Use all years of data Text size: Normal Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Maximum temperature															
Mean maximum temperature (°C)	28.5	28.5	26.6	24.0	20.0	17.4	17.0	18.7	21.2	23.7	25.9	28.6	23.3	14	1967 1984
Highest temperature (°C)	41.8	42.6	39.9	34.5	28.3	24.2	26.4	29.2	35.0	36.4	42.1	42.0	42.6	14	1967 1984
Date	10 Jan 1979	13 Feb 1979	09 Mar 1983	03 Apr 1980	14 May 1973	24 Jun 1973	20 Jul 1969	30 Aug 1982	30 Sep 1980	06 Oct 1980	25 Nov 1982	23 Dec 1972	13 Feb 1979		
Lowest maximum temperature (°C)	17.7	17.2	18.1	16.7	13.2	11.1	10.0	12.4	11.7	13.9	16.6	16.1	10.0	14	1967 1984
Date	28 Jan 1978	07 Feb 1973	09 Mar 1982	26 Apr 1967	31 May 1981	11 Jun 1978	03 Jul 1984	03 Aug 1981	27 Sep 1970	02 Oct 1973	10 Nov 1978	15 Dec 1971	03 Jul 1984		
Decile 1 maximum temperature (°C)	22.7	23.2	22.2	20.3	16.5	15.2	14.5	15.5	16.6	18.2	19.6	22.4		14	1967 1984
Decile 9 maximum temperature(°C)	35.1	34.2	31.2	28.0	23.4	19.5	19.6	22.2	26.9	30.0	32.8	35.4		14	1967 1984
Mean number of days ≥ 30 °C	10.4	8.9	5.1	0.7	0.0	0.0	0.0	0.0	0.9	2.9	5.6	10.2	44.7	14	1967 1984
Mean number of days ≥ 35 °C	3.2	2.5	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.2	1.5	3.2	11.2	14	1967 1984
Mean number of days ≥ 40 °C	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	2.0	14	1967 1984
Minimum temperature															
Mean minimum temperature (°C)	17.4	17.3	15.3	11.8	8.1	5.9	3.8	5.1	7.3	10.8	12.9	15.4	10.9	14	1967 1984
Lowest temperature (°C)	7.8	10.4	5.6	2.9	-1.1	-1.6	-4.9	-2.6	0.0	3.0	5.0	7.8	-4.9	14	1967 1984
Date	12 Jan 1969	22 Feb 1972	24 Mar 1967	28 Apr 1978	28 May 1969	20 Jun 1982	16 Jul 1970	05 Aug 1970	01 Sep 1967	01 Oct 1982	05 Nov 1974	29 Dec 1968	16 Jul 1970		
Highest minimum temperature (°C)	25.8	24.3	21.7	20.4	17.3	14.7	15.1	14.4	18.0	22.0	21.9	22.0	25.8	14	1967 1984
Date	23 Jan 1969	06 Feb 1973	06 Mar 1980	30 Apr 1968	01 May 1973	22 Jun 1979	18 Jul 1971	31 Aug 1969	25 Sep 1973	03 Oct 1981	19 Nov 1980	23 Dec 1972	23 Jan 1969		
Decile 1 minimum temperature (°C)	14.0	14.2	12.0	7.4	3.6	1.2	-0.3	1.4	3.4	6.5	9.3	11.6		14	1967 1984
Decile 9 minimum temperature (°C)	20.5	20.5	18.5	15.6	12.6	10.8	8.5	9.7	11.6	14.5	16.5	18.5		14	1967 1984
Mean number of days ≤ 2 °C	0.0	0.0	0.0	0.0	1.1	4.7	10.6	4.7	0.9	0.0	0.0	0.0	22.0	14	1967 1984
Mean number of days ≤ 0 °C	0.0	0.0	0.0	0.0	0.2	1.0	4.0	0.9	0.1	0.0	0.0	0.0	6.2	14	1967 1984
Ground surface temperature															
Mean daily ground minimum temperature (°C)	15.4	15.0	12.7	8.7	5.4	2.3	-0.2	1.4	3.6	7.8	10.1	12.4	7.9	13	1967 1984
Lowest ground temperature (°C)	4.0	6.8	0.0	-5.0	-4.4	-7.8	-12.2	-6.7	-3.9	-1.1	0.0	1.1	-12.2	13	1967 1984
Date	19 Jan 1969	22 Feb 1972	29 Mar 1984	24 Apr 1969	23 May 1982	25 Jun 1971	16 Jul 1970	05 Aug 1970	01 Sep 1967	13 Oct 1972	19 Nov 1967	04 Dec 1984	16 Jul 1970		
Mean number of days ground min. temp. ≤ -1 °C	0.0	0.0	0.0	0.4	1.0	6.8	13.0	8.0	2.7	0.1	0.0	0.0	32.0	13	1967 1984

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Rainfall															
Mean rainfall (mm)	93.5	93.4	88.9	64.9	60.0	66.3	33.5	47.5	37.7	55.6	73.9	74.1	790.1	59	1936 1996
Highest rainfall (mm)	311.2	435.9	328.5	382.0	238.1	416.7	191.0	347.0	158.6	195.6	365.5	277.2	1695.2	59	1936 1996
Date	1972	1956	1956	1988	1943	1950	1952	1986	1995	1976	1961	1962	1950		
Lowest rainfall (mm)	4.4	0.0	2.3	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	329.7	59	1936 1996
Date	1965	1939	1945	1980	1957	1962	1946	1995	1957	1988	1956	1939	1944		
Decile 1 rainfall (mm)	13.9	19.2	18.0	12.8	5.4	6.2	1.6	3.0	1.6	6.4	8.6	6.4	427.2	59	1936 1996
Decile 5 (median) rainfall (mm)	75.4	62.8	71.4	38.4	31.2	30.0	19.8	27.4	33.8	43.8	61.6	50.8	770.7	59	1936 1996
Decile 9 rainfall (mm)	183.5	224.7	184.3	160.2	155.4	157.1	64.1	122.2	80.4	135.3	150.9	175.4	1142.6	59	1936 1996
Highest daily rainfall (mm)	160.0	168.0	102.2	126.0	104.1	114.3	155.7	220.0	98.0	88.9	156.2	86.4	220.0	59	1936 1996
Date	16 Jan 1963	03 Feb 1990	20 Mar 1978	30 Apr 1988	02 May 1955	16 Jun 1950	28 Jul 1952	06 Aug 1986	25 Sep 1995	25 Oct 1938	09 Nov 1966	09 Dec 1963	06 Aug 1986		
Mean number of days of rain	8.2	8.3	8.2	6.2	6.7	6.0	4.6	5.4	5.5	7.0	7.6	6.8	80.5	59	1936 1996
Mean number of days of rain ≥ 1 mm	6.9	6.8	6.8	5.0	5.2	4.7	3.5	4.3	4.2	5.7	6.4	5.7	65.2	59	1936 1996
Mean number of days of rain ≥ 10 mm	2.7	2.5	2.6	1.9	1.4	1.8	0.8	1.3	1.1	1.7	2.0	2.5	22.3	59	1936 1996
Mean number of days of rain ≥ 25 mm	1.1	0.9	1.0	0.7	0.7	0.7	0.4	0.4	0.3	0.5	0.8	0.9	8.4	59	1936 1996

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Other daily elements															
Mean daily wind run (km)															
Maximum wind gust speed (km/h)															
Date															
Mean daily sunshine (hours)														8	1967 1982

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Mean daily solar exposure (MJ/m^2)	22.3	19.1	16.7	13.7	10.4	8.7	9.8	13.3	16.9	19.8	21.3	22.9	16.2	23	1990 2012
Mean number of clear days														0	1971 1971
Mean number of cloudy days														0	1971 1971
Mean daily evaporation (mm)	5.9	5.4	4.4	3.3	2.1	1.7	1.9	2.9	4.0	4.6	5.6	6.5	4.0	13	1967 1984

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
9 am conditions															
Mean 9am temperature (°C)	22.5	22.2	21.0	18.1	14.0	11.1	9.4	11.7	15.0	17.9	19.6	21.7	17.0	13	1967 1983
Mean 9am wet-bulb temperature (°C)	19.1	19.5	17.8	15.1	12.2	9.3	8.2	9.2	11.3	14.1	15.6	17.7	14.1	11	1967 1983
Mean 9am dew-point temperature (°C)														8	1972 1983
Mean 9am relative humidity (%)														8	1972 1983
Mean 9am cloud cover (oktas)	5.2	4.8	4.4	3.4	3.5	3.8	2.8	2.8	2.8	4.5	4.3	4.4	3.9	13	1967 1983
Mean 9am wind speed (km/h)	6.2	5.3	4.9	5.5	5.3	5.3	4.6	6.8	7.3	6.7	7.3	7.2	6.0	12	1967 1983

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
3 pm conditions															
Mean 3pm temperature (°C)															
Mean 3pm wet-bulb temperature (°C)															
Mean 3pm dew-point temperature (°C)															
Mean 3pm relative humidity (%)															
Mean 3pm cloud cover (oktas)														0	1971 1971
Mean 3pm wind speed (km/h)															

red = highest value blue = lowest value

Product IDCJCM0037 Prepared at Wed 22 Aug 2012 23:38:57 PM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_067068_All.shtml
- Summary statistics and locational map for this site: http://www.bom.gov.au/climate/averages/tables/cw_067068.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Data file (csv): http://www.bom.gov.au/clim_data/cdio/tables/text/IDCJCM0037_067068.csv
- Climate averages home page URL: http://www.bom.gov.au/climate/data/index.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Wed 22 Aug 2012 23:38:57 PM EST

This page was created at **on**

Australian Government
Bureau of Meteorology

Climate statistics for Australian locations

Monthly climate statistics

All years of record

Site information

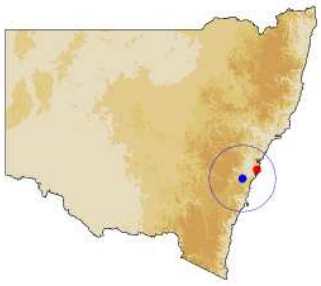
Site name: PICTON COUNCIL DEPOT
Site number: 068052
Latitude: 34.17 °S **Longitude:** 150.61 °E
Elevation: 165 m
Commenced: 1880 **Status:** Open
Latest available data: 31 Jul 2012

Additional information

Additional site information

Nearest alternative sites

1. 068192 CAMDEN AIRPORT AWS (15.8km)
2. 068081 CAMPBELLTOWN SWIMMING CENTRE (20.8km)
3. 067108 BADGERYS CREEK AWS (31.8km)



View larger map

Elevation - metres

View: Main statistics All available | Period: Use all years of data | Text size: Normal Large

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	29.3	28.6	27.0	23.7	20.2	17.3	16.8	18.2	21.4	24.0	26.3	28.5	23.4	61	1907 1975
Mean minimum temperature (°C)	15.2	15.4	13.1	9.2	5.7	3.2	1.7	2.9	5.2	8.8	11.5	14.0	8.8	61	1907 1975
Rainfall															
Mean rainfall (mm)	86.0	90.4	88.5	69.9	57.1	65.1	50.6	44.4	44.7	65.0	72.4	70.1	804.4	122	1880 2012
Decile 5 (median) rainfall (mm)	65.5	70.6	68.3	47.3	31.8	40.2	26.1	25.2	37.4	49.6	55.6	55.1	756.8	125	1880 2012
Mean number of days of rain ≥ 1 mm	6.9	6.9	7.2	5.7	5.0	5.4	4.7	4.9	5.2	6.3	6.8	6.5	71.5	122	1880 2012
Other daily elements															
Mean daily sunshine (hours)															
Mean number of clear days	4.7	4.5	7.0	10.2	9.8	8.4	13.4	10.9	11.0	7.5	6.7	6.0	100.1	10	1965 1975
Mean number of cloudy days	13.3	9.7	11.1	7.7	7.3	7.8	4.8	9.0	7.8	10.3	10.1	11.8	110.7	10	1965 1975
9 am conditions															
Mean 9am temperature (°C)	21.8	21.5	19.9	16.8	12.2	9.4	7.7	10.4	14.0	17.3	19.0	21.0	15.9	10	1965 1975
Mean 9am relative humidity (%)														0	1966 1966
Mean 9am wind speed (km/h)	6.8	4.5	5.1	4.6	6.0	4.7	5.1	7.3	7.8	8.6	9.0	6.5	6.3	10	1965 1975
3 pm conditions															
Mean 3pm temperature (°C)	26.4	25.4	24.5	22.5	18.3	15.7	15.6	16.2	19.0	21.3	23.1	25.6	21.1	10	1965 1975
Mean 3pm relative humidity (%)														0	1966 1966
Mean 3pm wind speed (km/h)														9	1965 1975

red = highest value blue = lowest value

Product IDCJCM0028 Prepared at Thu 23 Aug 2012 04:45:42 AM EST

Monthly statistics are only included if there are more than 10 years of data. The number of years (provided in the 2nd last column of the table) may differ between elements if the observing program at the site changed. More detailed data for individual sites can be obtained by contacting the Bureau.

Related Links

- This page URL: http://www.bom.gov.au/climate/averages/tables/cw_068052.shtml
- About climate averages: http://www.bom.gov.au/climate/cdo/about/about-stats.shtml
- Bureau of Meteorology website: http://www.bom.gov.au

Page created: Thu 23 Aug 2012 04:45:42 AM EST

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APPENDIX B

BOREHOLE LOGS AND EXPLANATION SHEETS

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 1

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S1 @ 0.0-0.2m		SILTY CLAY: dark brown, medium plasticity TOPSOIL	CL	FIRM	M
	B	0.5	SILTY CLAY: orange brown with occasional light grey, medium to high plasticity	CL/CH	STIFF TO VERY STIFF	M
		1.0	SHALE: dark grey with occasional light grey, fine grained, clayey seams		EXTREMELY LOW STRENGTH	M/D
		1.5	BOREHOLE DISCONTINUED AT 1.5 M ON WEATHERED SHALE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 2

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S2 @ 0.0-0.2m		SILTY CLAY: dark brown, medium plasticity	CL	FIRM	M
	B		TOPSOIL			
			SILTY CLAY: red brown with occasional orange brown, medium to high plasticity	CL/CH	STIFF	M
		0.5			VERY STIFF	
		1.0	SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	VERY STIFF	M
		1.5	SHALE: dark grey/brown with orange brown, fine grained, clayey seams		EXTREMELY LOW STRENGTH	D
			BOREHOLE DISCONTINUED AT 1.5 M ON WEATHERED SHALE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 3

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	B S3 @ 0.4 m		SILTY CLAY: dark brown, medium plasticity TOPSOIL	CL	FIRM	M
		0.5	SILTY CLAY: orange brown with light grey, medium to high plasticity, occasional gravel	CL/CH	STIFF	M
		1.0			VERY STIFF	
			SILTY CLAY: light grey with orange brown, medium to high plasticity	CL/CH	VERY STIFF	M
		1.5	BOREHOLED DISCONTINUED AT 1.5 M			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 4

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	B		SILTY CLAY: dark brown, medium plasticity TOPSOIL	CL	FIRM	M
	S4 @ 0.4 m	0.5	SILTY CLAY: red brown with orange brown, medium to high plasticity	CL/CH	VERY STIFF	M
		1.0	SHALE: dark grey, fine grained, clayey seams		EXTREMELY LOW STRENGTH	
		1.5	BOREHOLE DISCONTINUED AT 1.5 M ON WEATHERED SHALE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 5

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S5 @ 0.0-0.2 m		SILTY CLAY: dark brown, low plasticity, trace fine grained sand, trace of gravel	CL	STIFF	M/D
	B		TOPSOIL			
			SILTY CLAY: orange brown with light grey, medium plasticity, trace fine grained sand	CL	VERY STIFF	M
		0.5				
			SANDSTONE: orange brown with light grey and occasional red brown, fine to medium grained clayey seams		EXTREMELY LOW STRENGTH	
		1.0				
		1.5				
			AUGER REFUSAL AT 1.5 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 6

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	B		SILTY SANDY CLAY: dark brown, fine grained sand, low plasticity, occasional gravel TOPSOIL	CL	FIRM TO STIFF	M
	S6 @ 0.4 m	0.5	SILTY CLAY: orange brown with light grey, medium plasticity, trace of fine grained sand, trace of gravel	CL	VERY STIFF	M
		1.0	SANDSTONE: orange brown with light grey and occasional red brown, fine to medium grained clay seams		EXTREMELY LOW STRENGTH	D
		1.5	AUGER REFUSAL AT 1.5 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 7

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S7 @ 0.0-0.2		SILTY SANDY CLAY: dark brown, fine grained sand, low plasticity, trace of gravel	CL	FIRM TO STIFF	M
	B		TOPSOIL			
			SILTY SANDY CLAY: orange brown with light grey, fine grained sand, low plasticity occasional gravel	CL	VERY STIFF	M
		0.5				
		1.0	SANDSTONE: orange brown with light grey, fine to medium grained, clayey seams		EXTREMELY LOW STREGNTH	D
		1.5	BOREHOLE DISCONTINUED AT 1.5 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Inghams Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 8

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S8 @ 0.0-0.2 m		SILTY SANDY CLAY: dark brown, fine grained sand, low plasticity, occasional gravel TOPSOIL	CL	VERY STIFF	M
	B	0.5	SILTY CLAY: orange brown with light grey, medium plasticity, trace fine grained sand	CL	VERY STIFF	M
		1.0	SANDSTONE: orange brown with light grey and red brown, fine to medium grained, clayey seams		EXTREMELY LOW STRENGTH	D
		1.5	AUGER REFUSAL AT 1.3 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Ingham Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 9

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S9 @ 0.0-0.2 m		SILTY CLAY: dark brown with dark grey, low plasticity, trace of gravel (shale) FILL	CL	VERY STIFF	M/D
	B		SILTY CLAY: dark brown, low plasticity, trace fine grained sand	CL	STIFF TO VERY STIFF	M/D
			SILTY SANDY CLAY: orange brown with light grey, fine grained, medium plasticity	CL	STIFF TO VERY STIFF	M
		0.5				
		1.0			VERY STIFF	
			SILTY CLAY: light grey with orange brown, medium plasticity, trace fine grained sand	CL	VERY STIFF	M
		1.5	BOREHOLE DISCONTINUED AT 1.5 M			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Ingham site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 10

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY SANDY CLAY: dark brown, fine grained, low plasticity	CL	FIRM	M
	B		TOPSOIL			
	S10 @ 0.4 m		SILTY SANDY CLAY: orange brown with occasional light grey, fine grained, medium plasticity	CL	FIRM	M
		0.5			STIFF	
		1.0			VERY STIFF	
			SILTY CLAY: light grey with orange brown, medium plasticity, trace fine grained sand	CL	VERY STIFF	M
		1.5	BOREHOLE DISCONTINUED AT 1.5 M			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Inghams Property Development Pty Ltd
Project: Ingham Site, Tahmoor
Location: Refer to Drawing No. 12/1154

Project No.: 18661/2001C
Date : 14 August 2012
Logged: JK

BOREHOLE NO.: BH 11

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S11 @ 0.0-0.2 m		SILTY CLAY: dark brown, low to medium plasticity TOPSOIL	CL	FIRM	M
	B		SILTY CLAY: orange brown with occasional light grey, medium plasticity, trace fine grained sand	CL	FIRM	M
		0.5			STIFF TO VERY STIFF	
			SILTY SANDY CLAY: orange brown with light grey and red brown, fine grained sand, medium plasticity	CL	VERY STIFF	M
		1.0				
			SANDSTONE: light grey with orange brown, fine to medium grained, clayey seams		EXTREMELY LOW STRENGTH	D
		1.5	BOREHOLE DISCONTINUED AT 1.5 M ON WEATHERED SANDSTONE			
		2.0				
		2.5				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: INGHAMS SITE, TAHMOOR — Project No.: 18661/2001C
Client: INGHAMS PROPERTY DEVELOPMENT PTY LTD — Report No.: 12/1154
Address: LOCKED BAG 4000, LIVERPOOL BC NSW 1871 — Report Date: 20/08/2012
Test Method: AS 1289.6.3.2 — Page: 1 or 2

Site No.	P1	P2	P3	P4	P5	P6
Location	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	2	2	2	2	4	3
0.15 - 0.30	3	2	3	3	7	5
0.30 - 0.45	5	3	3	8	8	10
0.45 - 0.60	22	4	4	7	22	12
0.60 - 0.75	R	6	5	19	R	14
0.75 - 0.90		8	5	22		22
0.90 - 1.05		10	6	R		R
1.05 - 1.20		12	8			
1.20 - 1.35		10	10			
1.35 - 1.50		22	10			
1.50 - 1.65		R	D			
1.65 - 1.80						
1.80 - 1.95						
1.95 - 2.10						
2.10 - 2.25						
2.25 - 2.40						
2.40 - 2.55						
2.55 - 2.70						
2.70 - 2.85						
2.85 - 3.00						
3.00 - 3.15						
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						

Remarks: * Pre drilled prior to testing

Approved Signatory.....

Technician: JK

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: INGHAMS SITE, TAHMOOR — Project No.: 18661/2001C
Client: INGHAMS PROPERTY DEVELOPMENT PTY LTD — Report No.: 12/1154
Address: LOCKED BAG 4000, LIVERPOOL BC NSW 1871 — Report Date: 20/08/2012
Test Method: AS 1289.6.3.2 — Page: 2 or 2

Site No.	P7	P8	P9	P10	P11	
Location	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	Refer to Drawing No.: 12/1154	
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level	Surface Level	
Depth (m)	Penetration Resistance (blows / 150mm)					
0.00 - 0.15	4	10	12	2	1	
0.15 - 0.30	8	8	8	3	2	
0.30 - 0.45	13	8	5	2	2	
0.45 - 0.60	22	12	6	3	3	
0.60 - 0.75	R	15	7	5	5	
0.75 - 0.90		22	10	7	10	
0.90 - 1.05		R	12	8	8	
1.05 - 1.20			17	10	11	
1.20 - 1.35			22	10	22	
1.35 - 1.50			M	9	R	
1.50 - 1.65				D		
1.65 - 1.80						
1.80 - 1.95						
1.95 - 2.10						
2.10 - 2.25						
2.25 - 2.40						
2.40 - 2.55						
2.55 - 2.70						
2.70 - 2.85						
2.85 - 3.00						
3.00 - 3.15						
3.15 - 3.30						
3.30 - 3.45						
3.45 - 3.60						
3.60 - 3.75						

Remarks: * Pre drilled prior to testing

Approved Signatory.....

Technician: JK

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by SMEC in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarized in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).

- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - low to medium plasticity	H

(b) Grading

"Well graded" Good representation of all particle sizes from the largest to the smallest.

"Poorly graded" One or more intermediate sizes poorly represented

"Gap graded" One or more intermediate sizes absent

"Uniformly graded" Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black White Grey Red
Brown Orange Yellow Green
Blue

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg. red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

E1.3 ***S****oil Condition*

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 – 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 – 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 – 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 – 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 – 3	0 - 2	0 - 15
Loose	3 – 8	2 - 5	15 - 35
Medium Dense	8 – 25	5 - 15	35 - 65
Dense	25 – 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

“Residual Soil” - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

“Colluvium” - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

“Landslide Debris” - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

“Alluvium” - Material which has been transported essentially by water. Usually associated with former stream activity.

“Fill” - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes “O” or “H” depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an “organic material” by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX C

LABORATORY TEST RESULTS

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 1
Project No.: 18661

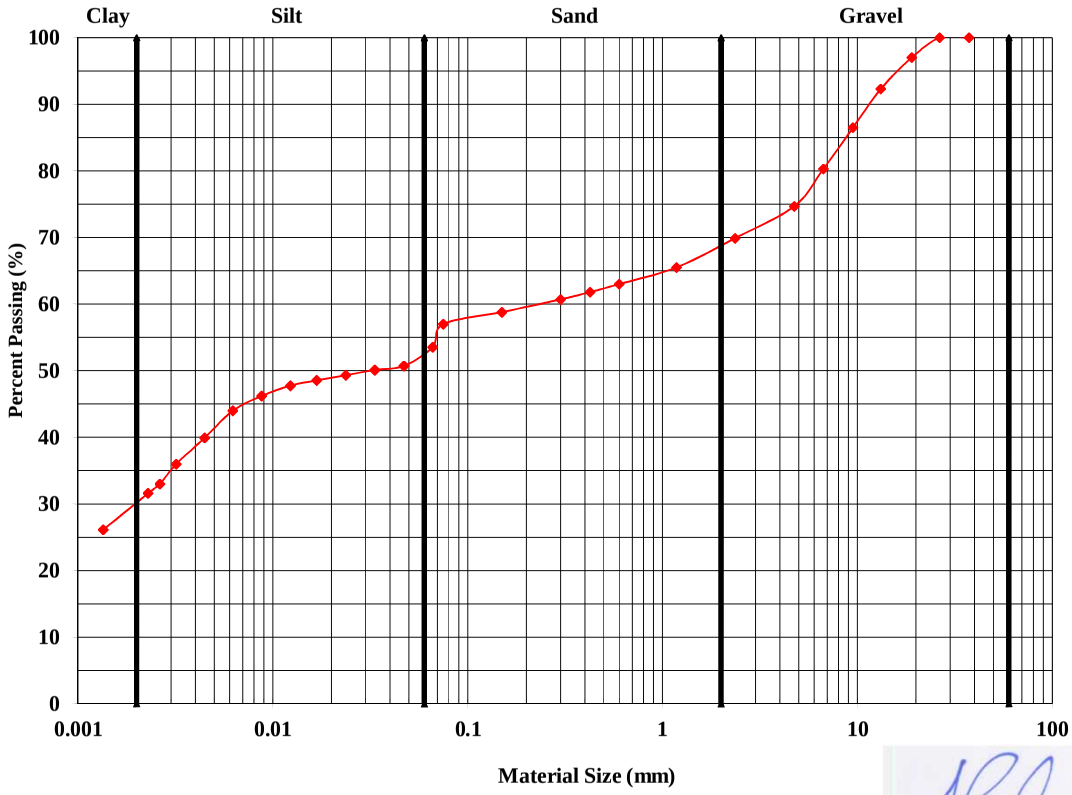
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 1 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.5
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 1 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Sandy Silty Clayey Gravel, brown/orange-brown



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	97
13.2	92.3
9.5	86.5
6.7	80.3
4.75	74.7
2.36	69.9
1.18	65.5
0.60	63
0.425	61.8
0.30	60.7
0.15	58.8
0.075	57
*Particle Size (mm)	Percent Passing (%)
0.0661	53.6
0.0472	50.7
0.0334	50.1
0.0237	49.3
0.0168	48.5
0.0123	47.8
0.0087	46.2
0.0062	44.0
0.0045	39.9
0.0032	36.0
0.0026	33.0
0.0023	31.6
0.0013	26.1

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory
Lincoln Coleman - Senior Geotechnician

Technician: LC

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 2
Project No.: 18661

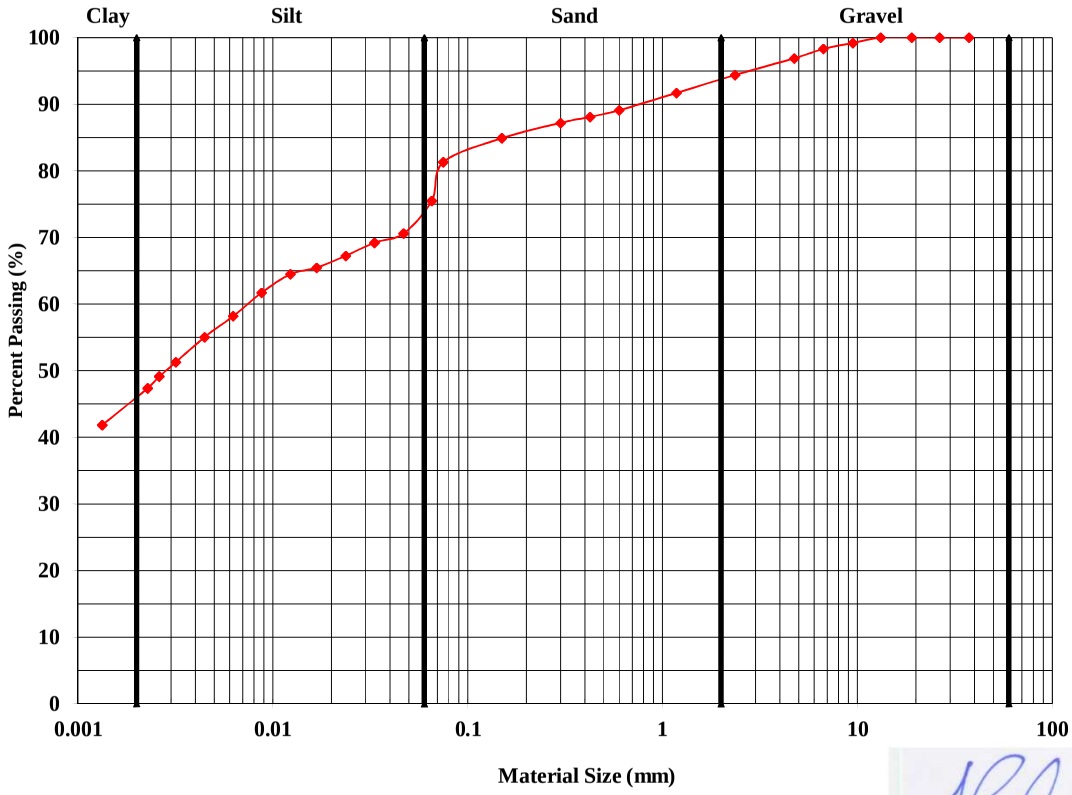
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 2 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 2 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Sandy Silty Clay, brown/red-brown, some gravel



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	100
9.5	99.2
6.7	98.3
4.75	96.9
2.36	94.4
1.18	91.7
0.60	89.1
0.425	88.1
0.30	87.2
0.15	84.9
0.075	81.3
*Particle Size (mm)	Percent Passing (%)
0.0654	75.5
0.0469	70.6
0.0333	69.2
0.0236	67.2
0.0168	65.5
0.0123	64.5
0.0088	61.7
0.0063	58.2
0.0045	55.0
0.0032	51.3
0.0026	49.1
0.0023	47.4
0.0013	41.8

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory.

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 3
Project No.: 18661

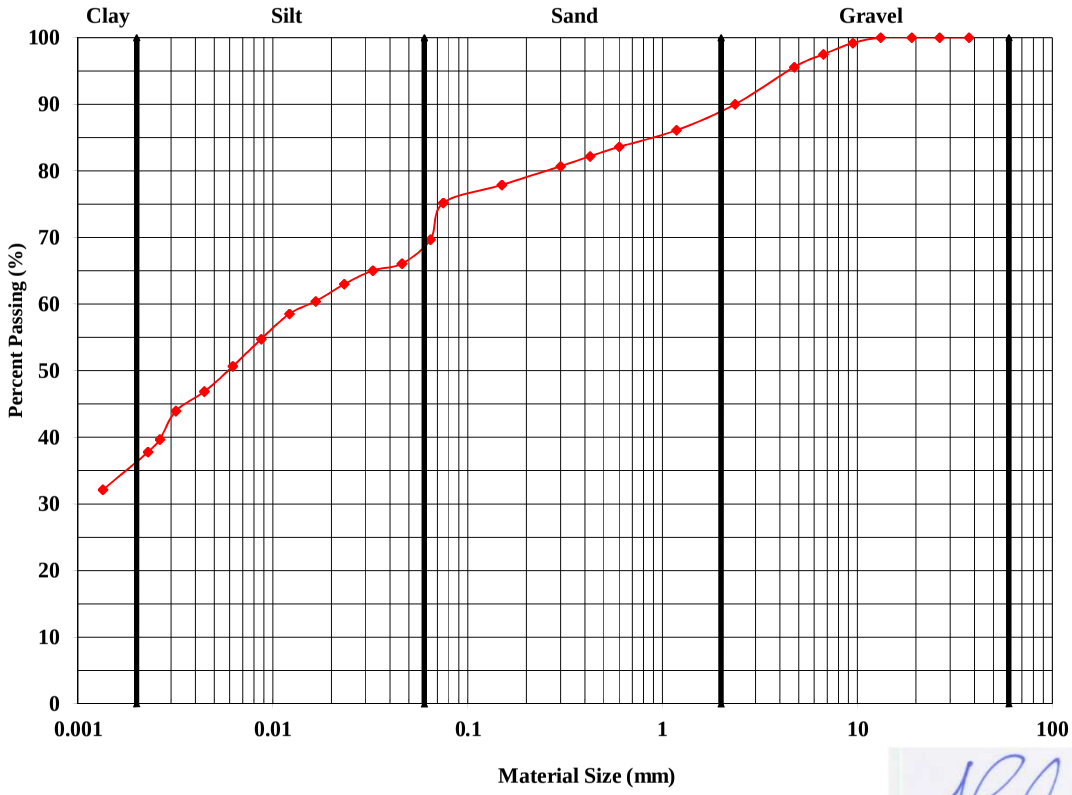
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 3 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 3 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Gravelly Sandy Silty Clay, brown/yellow-brown



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	100
9.5	99.2
6.7	97.5
4.75	95.6
2.36	90
1.18	86.1
0.60	83.6
0.425	82.2
0.30	80.7
0.15	77.9
0.075	75.2
*Particle Size (mm)	Percent Passing (%)
0.0644	69.7
0.0460	66.1
0.0327	65.1
0.0232	63.0
0.0166	60.4
0.0122	58.5
0.0087	54.8
0.0062	50.7
0.0045	46.9
0.0032	44.0
0.0026	39.7
0.0023	37.8
0.0013	32.1

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory.

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 4
Project No.: 18661

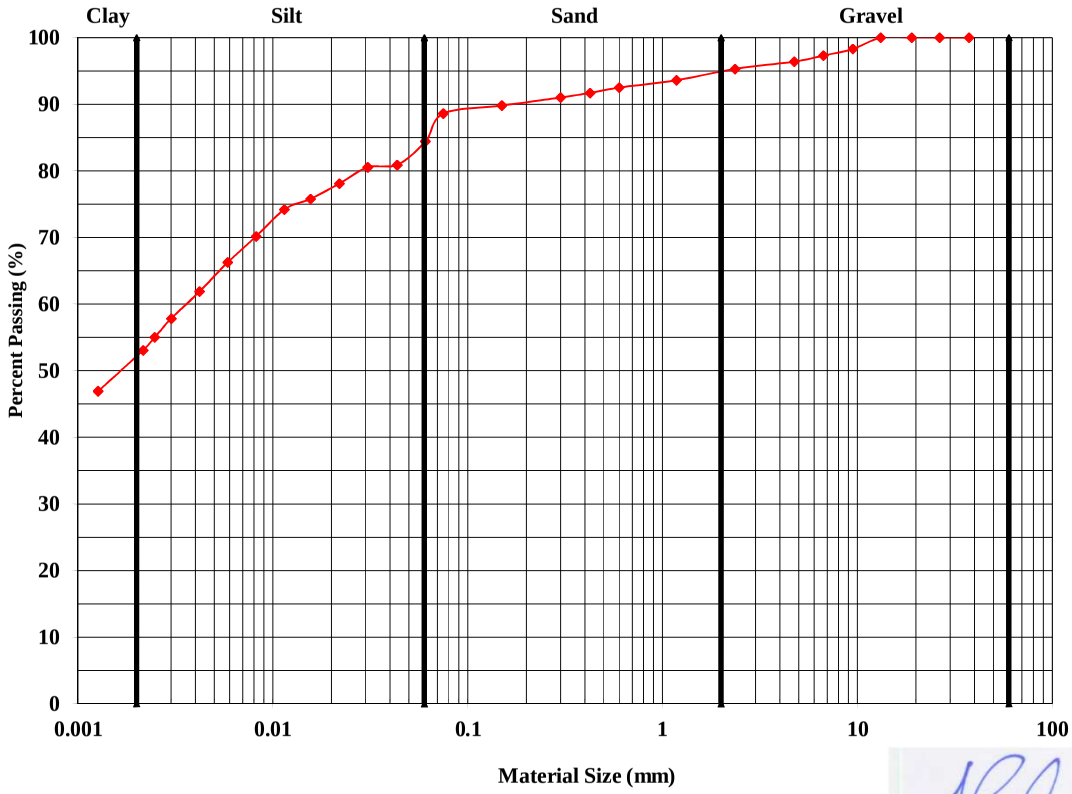
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 4 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.5
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 4 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Sandy Silty Clay, red-brown & yellow-brown, some gravel



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	100
9.5	98.3
6.7	97.3
4.75	96.4
2.36	95.3
1.18	93.6
0.60	92.5
0.425	91.7
0.30	91
0.15	89.8
0.075	88.6
*Particle Size (mm)	Percent Passing (%)
0.0608	84.4
0.0435	80.9
0.0308	80.6
0.0219	78.1
0.0156	75.8
0.0115	74.2
0.0082	70.2
0.0059	66.3
0.0042	61.9
0.0030	57.8
0.0025	55.0
0.0022	53.1
0.0013	46.9

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory.

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 5
Project No.: 18661

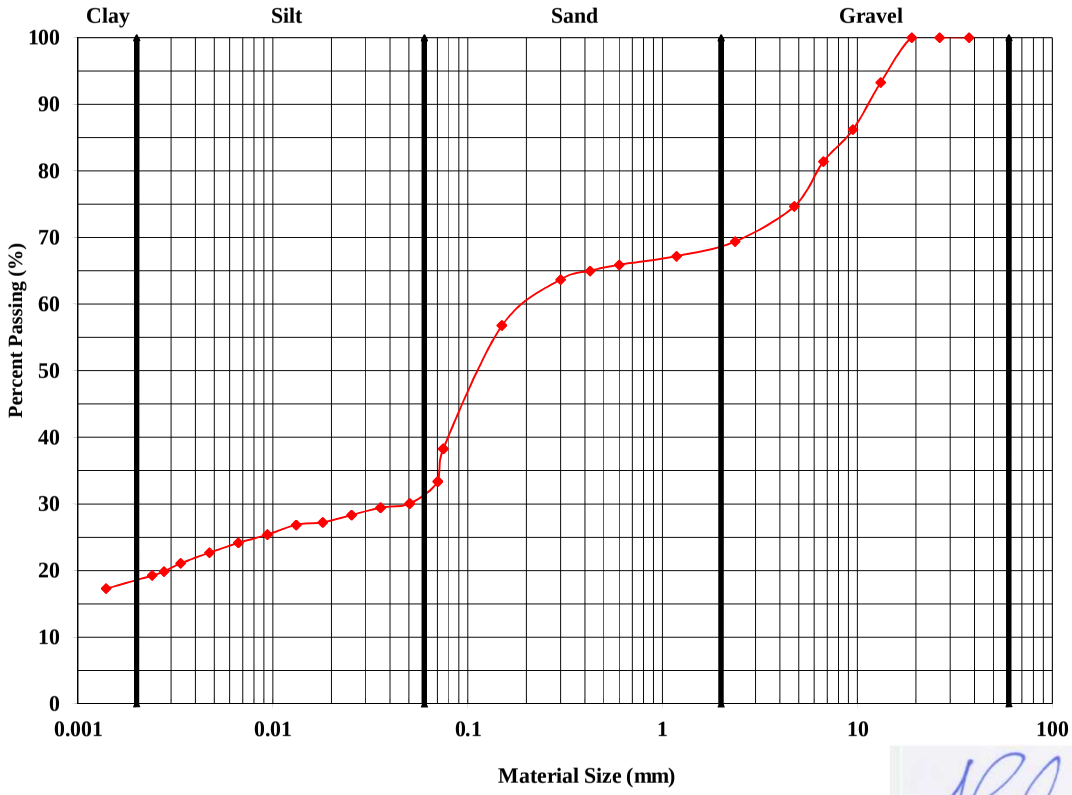
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 5 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 5 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Silty Clayey Gravelly Sand, orange-brown & yellow-brown



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	93.3
9.5	86.2
6.7	81.4
4.75	74.7
2.36	69.4
1.18	67.2
0.60	65.9
0.425	65
0.30	63.7
0.15	56.8
0.075	38.3
*Particle Size (mm)	Percent Passing (%)
0.0702	33.4
0.0503	30.1
0.0357	29.4
0.0253	28.3
0.0180	27.2
0.0132	26.9
0.0094	25.4
0.0067	24.2
0.0047	22.7
0.0034	21.1
0.0028	19.9
0.0024	19.2
0.0014	17.3

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory..

Technician: LC

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Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 6
Project No.: 18661

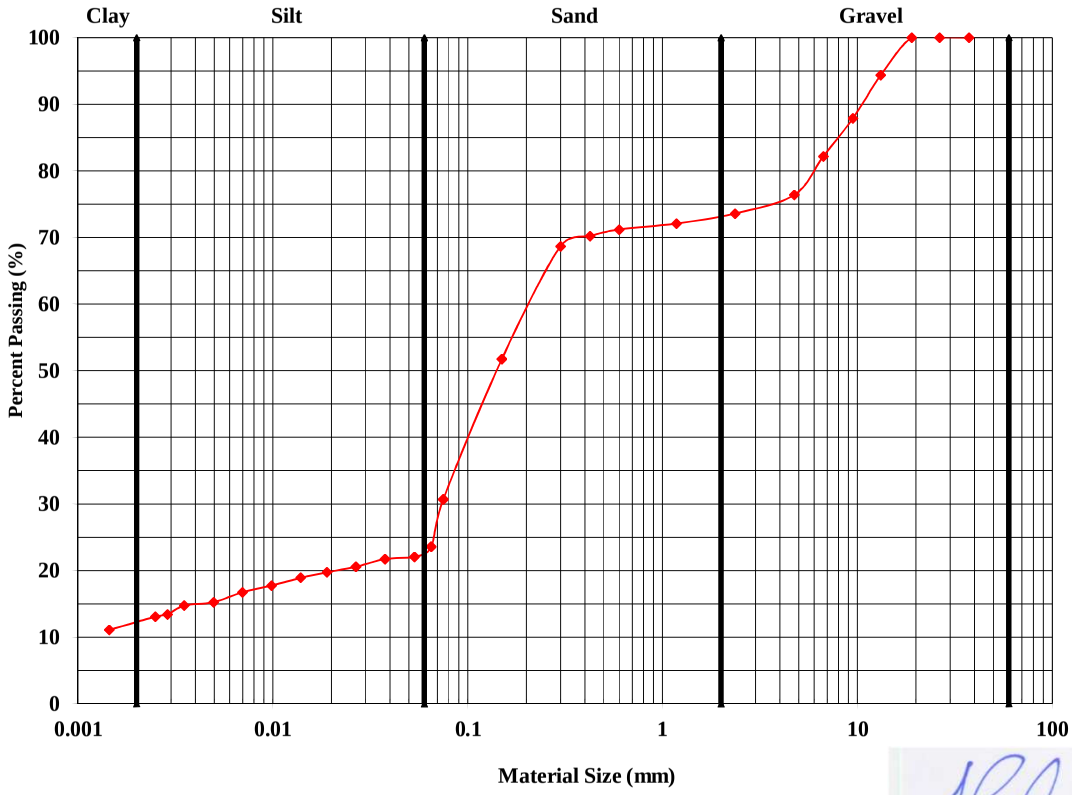
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 6 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 6 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Gravelly Sand, brown/light brown, some clay, some silt



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	94.4
9.5	87.9
6.7	82.2
4.75	76.4
2.36	73.6
1.18	72.1
0.60	71.2
0.425	70.2
0.30	68.7
0.15	51.8
0.075	30.7
*Particle Size (mm)	Percent Passing (%)
0.0650	23.6
0.0533	22.1
0.0377	21.7
0.0268	20.6
0.0190	19.7
0.0139	18.9
0.0098	17.7
0.0070	16.7
0.0050	15.2
0.0035	14.7
0.0029	13.4
0.0025	13.1
0.0014	11.1

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory.

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 7
Project No.: 18661

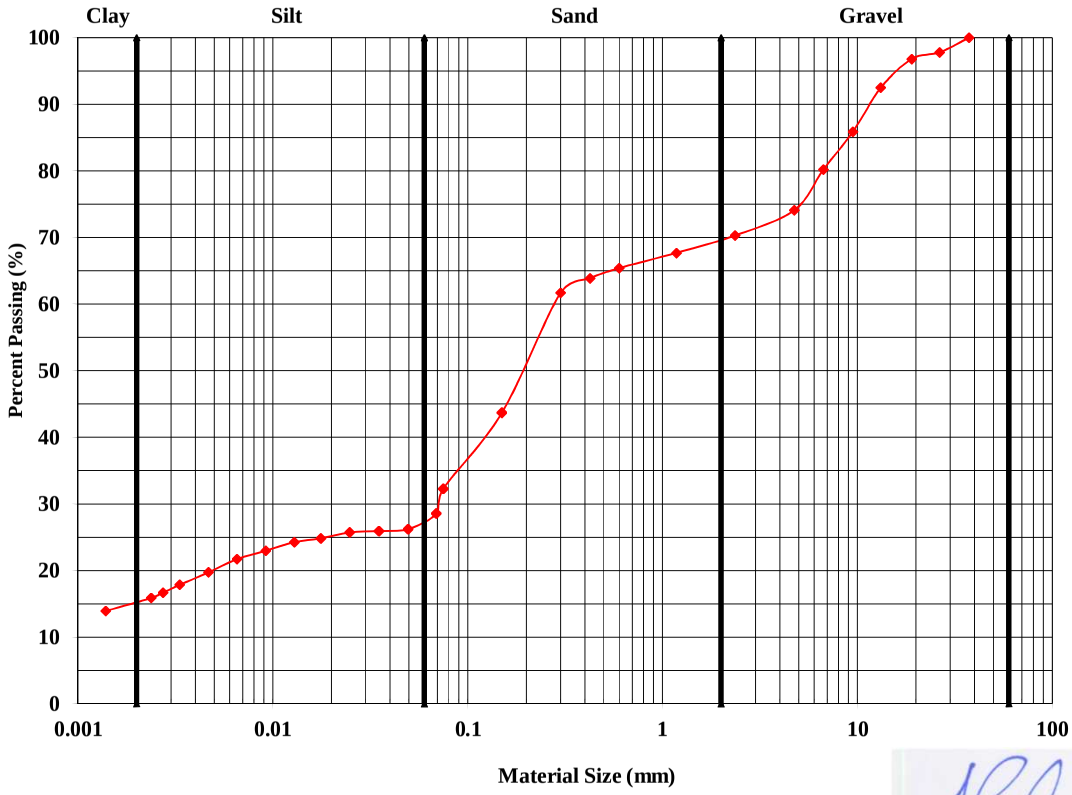
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 7 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 7 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Clayey Gravelly Sand, brown/light brown, some silt



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	97.8
19.0	96.8
13.2	92.5
9.5	85.9
6.7	80.2
4.75	74.1
2.36	70.3
1.18	67.7
0.60	65.4
0.425	63.9
0.30	61.7
0.15	43.7
0.075	32.3
*Particle Size (mm)	Percent Passing (%)
0.0691	28.6
0.0495	26.2
0.0350	25.9
0.0248	25.7
0.0176	24.8
0.0129	24.2
0.0092	23.0
0.0065	21.7
0.0047	19.7
0.0033	17.9
0.0027	16.7
0.0024	15.9
0.0014	13.9

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory..

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 8
Project No.: 18661

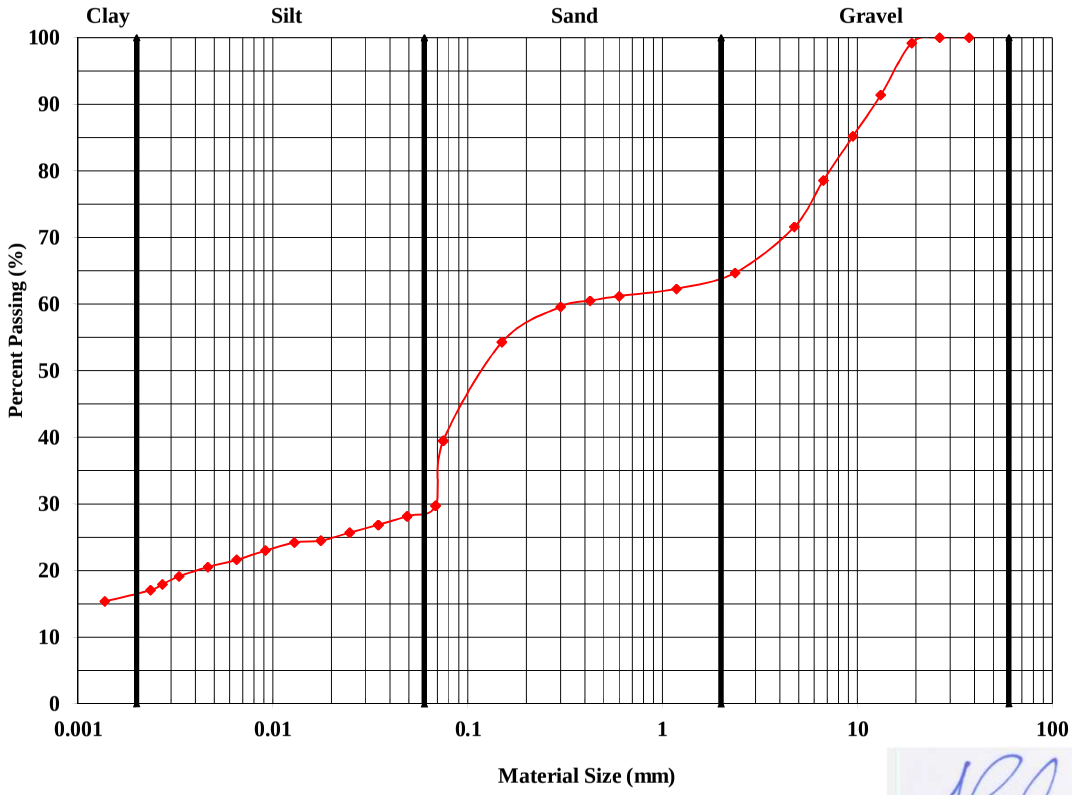
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 8 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 8 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Silty Clayey Sandy Gravel, light brown



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	99.2
13.2	91.4
9.5	85.2
6.7	78.6
4.75	71.6
2.36	64.7
1.18	62.3
0.60	61.2
0.425	60.5
0.30	59.6
0.15	54.3
0.075	39.5
*Particle Size (mm)	Percent Passing (%)
0.0685	29.8
0.0489	28.2
0.0348	26.9
0.0247	25.7
0.0176	24.5
0.0129	24.2
0.0092	23.0
0.0065	21.6
0.0046	20.5
0.0033	19.1
0.0027	17.9
0.0024	17.0
0.0014	15.4

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory.

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 9
Project No.: 18661

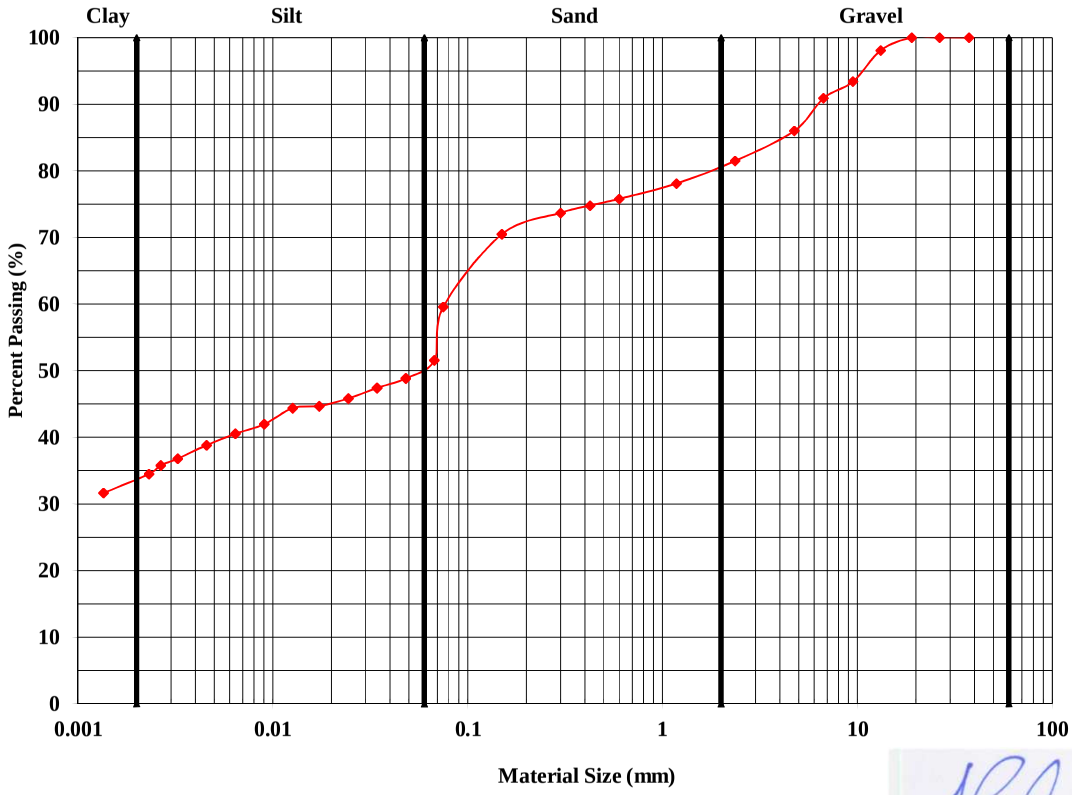
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 9 Refer to Drawing No: 12/1
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 9 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Silty Gravelly Sandy Clay, red-brown, yellow-brown & grey



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	98.1
9.5	93.4
6.7	90.9
4.75	86
2.36	81.5
1.18	78.1
0.60	75.8
0.425	74.8
0.30	73.7
0.15	70.5
0.075	59.6
*Particle Size (mm)	Percent Passing (%)
0.0675	51.6
0.0482	48.8
0.0343	47.4
0.0244	45.8
0.0173	44.7
0.0126	44.4
0.0090	42.0
0.0064	40.5
0.0046	38.8
0.0032	36.8
0.0027	35.8
0.0023	34.5
0.0014	31.6

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory. Lincoln Coleman - Senior Geotechnician

Technician: LC

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 10
Project No.: 18661

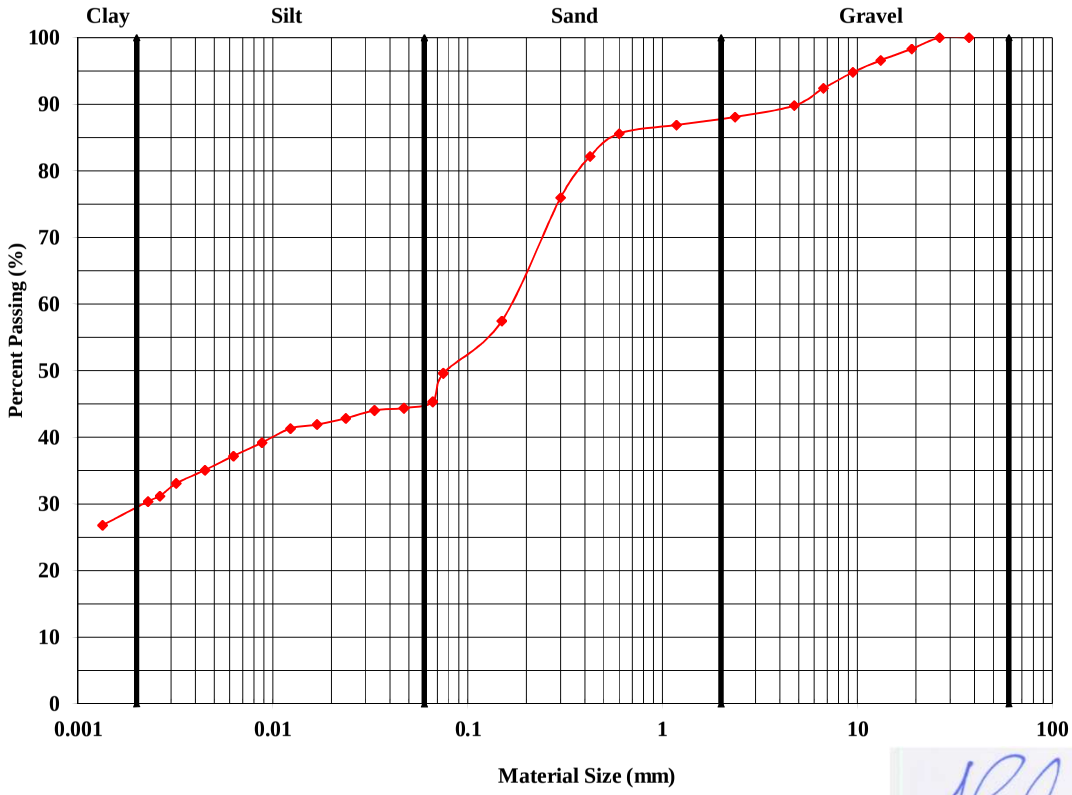
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 10 Refer to Drawing No: 12/
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 10 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Gravelly Silty Sandy Clay, yellow-brown & grey



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	98.3
13.2	96.6
9.5	94.8
6.7	92.4
4.75	89.8
2.36	88.1
1.18	86.9
0.60	85.6
0.425	82.2
0.30	76
0.15	57.5
0.075	49.6
*Particle Size (mm)	Percent Passing (%)
0.0662	45.3
0.0470	44.4
0.0333	44.0
0.0237	42.9
0.0168	41.9
0.0123	41.3
0.0088	39.2
0.0063	37.2
0.0045	35.1
0.0032	33.1
0.0026	31.2
0.0023	30.4
0.0013	26.8

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory..

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Particle Size Distribution

Project: Inghams Site, Tahmoor
STS / Sample No.: 2001C / 11
Project No.: 18661

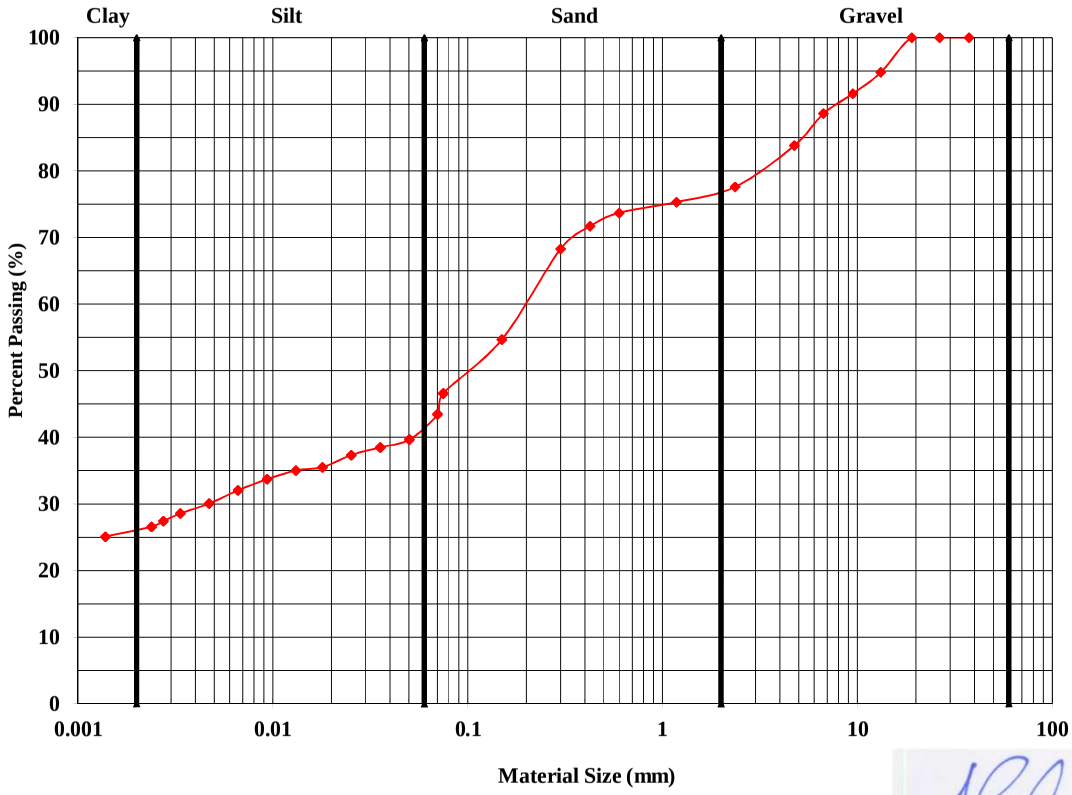
Client: Inghams Property Development Pty Ltd
Sample Location: Borehole 11 Refer to Drawing No: 12/
Report No.: 13/0840

Address: Locked Bag 4000, Liverpool BC NSW 1871
Depth (m): 0.0 - 0.4
Report Date: 28/05/2013

Test Method: AS1289.3.6.1, 3.6.3
Method of Despersion: Mechanical Stirrer
Page: 11 of 13

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

Material Description: Silty Gravelly Clayey Sand, orange-brown



Sieve Size (mm)	Percent Passing (%)
37.5	100
26.5	100
19.0	100
13.2	94.8
9.5	91.6
6.7	88.6
4.75	83.8
2.36	77.6
1.18	75.3
0.60	73.7
0.425	71.7
0.30	68.3
0.15	54.7
0.075	46.6
*Particle Size (mm)	Percent Passing (%)
0.0701	43.5
0.0502	39.7
0.0356	38.5
0.0253	37.3
0.0180	35.5
0.0131	35.0
0.0093	33.7
0.0066	32.0
0.0047	30.1
0.0033	28.6
0.0027	27.4
0.0024	26.6
0.0014	25.1

*Particle Size obtained by Hydrometer Analysis.
Hydrometer Type: g/L

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory..

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Emerson Class No.

Project: Inghams Site, Tahmoor — Project No.: 18661
Client: Inghams Property Development Pty Ltd — Report No.: 13/0840
Address: Locked Bag 4000, Liverpool BC NSW 1871 — Report Date: 28/05/2013
Test Method: AS1289.3.8.1 —

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

STS / Sample No.	2001C / 1	2001C / 2	2001C / 3	2001C / 4	2001C / 5	2001C / 6
Sample Location	Borehole 1 Refer to Drawing No: 12/1154	Borehole 2 Refer to Drawing No: 12/1154	Borehole 3 Refer to Drawing No: 12/1154	Borehole 4 Refer to Drawing No: 12/1154	Borehole 5 Refer to Drawing No: 12/1154	Borehole 5 Refer to Drawing No: 12/1154
Material Description	Sandy Silty Clayey Gravel, brown/orange-brown	Sandy Silty Clay, brown/red-brown, some gravel	Gravelly Sandy Silty Clay, brown/yellow-brown	Sandy Silty Clay, red-brown & yellow-brown, some gravel	Silty Clayey Gravelly Sand, orange-brown & yellow-brown	Gravelly Sand, brown/light brown, some clay, some silt
Depth (mm)	0.0 - 0.5	0.0 - 0.4	0.0 - 0.4	0.0 - 0.5	0.0 - 0.4	0.0 - 0.4
Sample Date	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012
Date Tested	3/09/2002	3/09/2002	3-Sep-02	3-Sep-02	3-Sep-02	3-Sep-02
Source of Material	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample
Water Temperature (°)	18	18	18	18	18	18
Emerson Class No.	**5**	**5**	**5**	**5**	**5**	**5**

Emerson Classification

Class 1: Slaking and complete dispersion before remoulding

Class 2: Slaking and some dispersion before remoulding

Class 3: Slaking and no dispersion before remoulding, dispersion after remoulding

Class 4: Slaking and no despersion before remoulding, no dispersion after remoulding, calcite or gypsum present

Class 5: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, dispersion after slaking in a 1:5 soil / water suspension

Class 6: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, flocculation after shaking in a 1:5 soil / water suspension

Class 7: No slaking, swelling occurs

Class 8: No slaking, swelling does not occur

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory: 

Technician: LC

Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Emerson Class No.

Project: Inghams Site, Tahmoor
Client: Inghams Property Development Pty Ltd
Address: Locked Bag 4000, Liverpool BC NSW 1871
Test Method: AS1289.3.8.1

Project No.: 18661
Report No.: 13/0840
Report Date: 28/05/2013

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

STS / Sample No.	2001C / 7	2001C / 8	2001C / 9	2001C / 10	2001C / 11	
Sample Location	Borehole 7 Refer to Drawing No: 12/1154	Borehole 8 Refer to Drawing No: 12/1154	Borehole 9 Refer to Drawing No: 12/1154	Borehole 10 Refer to Drawing No: 12/1154	Borehole 11 Refer to Drawing No: 12/1154	
Material Description	Clayey Gravelly Sand, brown/light brown, some silt	Silty Clayey Sandy Gravel, light brown	Silty Gravelly Sandy Clay, red-brown, yellow-brown & grey	Gravelly Silty Sandy Clay, yellow-brown & grey	Silty Gravelly Clayey Sand, orange-brown	
Depth (mm)	0.0 - 0.4	0.0 - 0.4	0.0 - 0.4	0.0 - 0.4	0.0 - 0.4	
Sample Date	14/08/2012	14/08/2012	14/08/2012	14/08/2012	14/08/2012	
Date Tested	3/09/2002	3/09/2002	3-Sep-02	3-Sep-02	3-Sep-02	
Source of Material	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample	Disturbed Sample	
Water Temperature (°)	18	18	18	18	18	
Emerson Class No.	**5**	**5**	**5**	**5**	**5**	

Emerson Classification

Class 1: Slaking and complete dispersion before remoulding

Class 2: Slaking and some dispersion before remoulding

Class 3: Slaking and no dispersion before remoulding, dispersion after remoulding

Class 4: Slaking and no despersion before remoulding, no dispersion after remoulding, calcite or gypsum present

Class 5: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, dispersion after slaking in a 1:5 soil / water suspension

Class 6: Slaking and no dispersion before remoulding, no dispersion after remoulding, no calcite or gypsum present, flocculation after shaking in a 1:5 soil / water suspension

Class 7: No slaking, swelling occurs

Class 8: No slaking, swelling does not occur

Remarks: **This report is a reissue of Report No: 12/1268. Project and client details corrected. No technical data changed.**

Approved Signatory. 

Technician: LC

Lincoln Coleman - Senior Geotechnician

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1220049**	Page	: 1 of 5
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MATTHEW GREEN	Contact	: Client Services
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: mgreen@smectesting.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: TAHNOOR 18661 2001C	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 09520		
C-O-C number	: ----	Date Samples Received	: 17-AUG-2012
Sampler	: JK	Issue Date	: 24-AUG-2012
Site	: ----		
		No. of samples received	: 11
Quote number	: EN/025/11	No. of samples analysed	: 11

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: S1	S2	S3	S4	S5
				Client sampling date / time: 14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
				ES1220049-001	ES1220049-002	ES1220049-003	ES1220049-004	ES1220049-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.0**	**7.0**	**6.9**	**6.7**	**7.1**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**56**	**43**	**39**	**38**	**79**
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**7.8**	**2.2**	**0.8**	<0.1	**3.0**
Exchangeable Magnesium	----	0.1	meq/100g	**2.5**	**1.3**	**5.1**	**1.9**	**2.6**
Exchangeable Potassium	----	0.1	meq/100g	**1.2**	**1.6**	**0.1**	<0.1	**1.0**
Exchangeable Sodium	----	0.1	meq/100g	<0.1	**0.2**	**0.6**	**0.2**	<0.1
Cation Exchange Capacity	----	0.1	meq/100g	**11.6**	**5.2**	**6.6**	**2.2**	**6.6**
Exchangeable Sodium Percent	----	0.1	%	**0.6**	**3.0**	**9.6**	**8.2**	**0.4**
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	**2000**	**2440**	**1950**	**1660**	**1250**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	S6	S7	S8	S9	S10
			Client sampling date / time	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00	14-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	ES1220049-006	ES1220049-007	ES1220049-008	ES1220049-009	ES1220049-010
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	6.6	7.2	6.8	6.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	57	21	60	32	29
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	1.3	1.4	6.7	3.9	0.7
Exchangeable Magnesium	----	0.1	meq/100g	1.4	2.3	1.3	1.3	3.8
Exchangeable Potassium	----	0.1	meq/100g	0.4	0.3	0.2	0.3	0.2
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	0.1
Cation Exchange Capacity	----	0.1	meq/100g	3.1	4.0	8.3	5.6	4.8
Exchangeable Sodium Percent	----	0.1	%	1.0	1.0	0.2	0.5	2.7
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	1590	803	753	1170	755

Analytical Results

Sub-Matrix: SOIL			Client sample ID	S11	----	----	----	----
			Client sampling date / time	14-AUG-2012 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1220049-011	----	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**6.6**	----	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**47**	----	----	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**5.1**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**2.7**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	**0.7**	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**8.5**	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	**0.6**	----	----	----	----
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	**834**	----	----	----	----

Environmental Division

QUALITY CONTROL REPORT

Work Order	: **ES1220049**	Page	: 1 of 4
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR MATTHEW GREEN	Contact	: Client Services
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: mgreen@smectesting.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: TAHNOOR 18661 2001C	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 17-AUG-2012
Sampler	: JK	Issue Date	: 24-AUG-2012
Order number	: 09520		
		No. of samples received	: 11
Quote number	: EN/025/11	No. of samples analysed	: 11

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA002 : pH (Soils) (QC Lot: 2456487)									
ES1219787-002	Anonymous	EA002: pH Value	----	0.1	pH Unit	7.1	7.1	0.0	0% - 20%
ES1220049-005	S5	EA002: pH Value	----	0.1	pH Unit	7.1	7.0	0.0	0% - 20%
EA010: Conductivity (QC Lot: 2456488)									
ES1219857-001	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	212	210	0.8	0% - 20%
ES1220049-003	S3	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	39	38	0.0	0% - 20%
ED008: Exchangeable Cations (QC Lot: 2461967)									
ES1220049-001	S1	ED008: Exchangeable Calcium	----	0.1	meq/100g	7.8	8.3	5.4	0% - 20%
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	2.5	2.6	0.0	0% - 20%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	1.2	1.2	0.0	0% - 50%
		ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
ES1220049-009	S9	ED008: Exchangeable Calcium	----	0.1	meq/100g	3.9	3.7	5.7	0% - 20%
		ED008: Exchangeable Magnesium	----	0.1	meq/100g	1.3	1.3	0.0	0% - 50%
		ED008: Exchangeable Potassium	----	0.1	meq/100g	0.3	0.3	0.0	No Limit
		ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
EK072: Phosphate Sorption Capacity (QC Lot: 2460566)									
ES1220049-001	S1	EK072: Phosphate Sorption Capacity	----	250	mg P sorbed/kg	2000	1930	3.6	No Limit
ES1220049-011	S11	EK072: Phosphate Sorption Capacity	----	250	mg P sorbed/kg	834	904	8.1	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (QCLot: 2456488)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1412 µS/cm	99.8	70	130
ED008: Exchangeable Cations (QCLot: 2461967)								
ED008: Exchangeable Calcium	----	0.1	meq/100g	<0.1	1 meq/100g	98.9	70	130
ED008: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	1.67 meq/100g	98.1	70	130
ED008: Exchangeable Potassium	----	0.1	meq/100g	<0.1	.52 meq/100g	91.8	70	130
ED008: Exchangeable Sodium	----	0.1	meq/100g	<0.1	.87 meq/100g	103	70	130
ED008: Exchangeable Sodium Percent	----	0.1	%	<0.1	----	----	----	----
ED008: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	4.06 meq/100g	98.4	77	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) Results are required to be reported.**

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1220049**	Page	: 1 of 5
Client	: SMEC TESTING SERVICES PTY LTD	Laboratory	: Environmental Division Sydney
Contact	: MR MATTHEW GREEN	Contact	: Client Services
Address	: P O BOX 6989 WETHERILL PARK NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: mgreen@smectesting.com.au	E-mail	: sydney@alsglobal.com
Telephone	: ----	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: TAHNOOR 18661 2001C	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 17-AUG-2012
Sampler	: JK	Issue Date	: 24-AUG-2012
Order number	: 09520		
		No. of samples received	: 11
Quote number	: EN/025/11	No. of samples analysed	: 11

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002 : pH (Soils)							
Soil Glass Jar - Unpreserved (EA002)							
S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11	**14-AUG-2012**	**20-AUG-2012**	21-AUG-2012	✓	**20-AUG-2012**	20-AUG-2012	✓
EA010: Conductivity							
Soil Glass Jar - Unpreserved (EA010)							
S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11	**14-AUG-2012**	**20-AUG-2012**	21-AUG-2012	✓	**21-AUG-2012**	17-SEP-2012	✓
ED008: Exchangeable Cations							
Pulp Bag (ED008)							
S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11	**14-AUG-2012**	**23-AUG-2012**	11-SEP-2012	✓	**23-AUG-2012**	11-SEP-2012	✓
EK072: Phosphate Sorption Capacity							
Soil Glass Jar - Unpreserved (EK072)							
S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11	**14-AUG-2012**	**----**	----	----	**23-AUG-2012**	10-FEB-2013	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5)	EA010	2	19	**10.5**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations with pre-treatment	ED008	2	11	**18.2**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
P Sorption Index & P Sorption Capacity	EK072	2	11	**18.2**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	2	17	**11.8**	**10.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations with pre-treatment	ED008	1	11	**9.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	19	**5.3**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Exchangeable Cations with pre-treatment	ED008	1	11	**9.1**	**5.0**	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	(APHA 21st ed., 4500H+) pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 103)
Electrical Conductivity (1:5)	EA010	SOIL	(APHA 21st ed., 2510) Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 104)
Exchangeable Cations with pre-treatment	ED008	SOIL	Rayment & Higginson (1992) Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM (1999) Schedule B(3) (Method 301)
P Sorption Index & P Sorption Capacity	EK072	SOIL	Rayment & Higginson (1992) Method 9H1 & 9I1 Soil is bought to equilibrium with a solution of P at known concentration. P absorbed, released is determined by FIA analysis of the final solution.

Preparation Methods	Method	Matrix	Method Descriptions
Exchangeable Cations Preparation Method	ED007PR	SOIL	Rayment & Higginson (1992) method 15A1. A 1M NH4Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- **No Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

APPENDIX D

WATER BALANCE CALCULATIONS

MONTHLY WATER BALANCE USED TO DETERMINE WET WEATHER STORAGE

Design Wastewater Flow	Q	l/day	840
Design Percolation Rate	R	mm/wk	23.3
Land Area	L	m^2	280

Paramters	**Symbol**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
Days in Month	D	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365
Precipitation	P	-	mm/month	65.5	70.6	68.3	47.3	31.8	40.2	26.1	25.2	37.4	49.6	55.6	55.1	572.7
Evaporation	E	-	mm/month	182.9	151.2	136.4	99	65.1	51	58.9	89.9	120	142.6	168	201.5	1466.5
Crop Factor	C	-	-	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-
Inputs																
Precipitation	P	-	mm/month	65.5	70.6	68.3	47.3	31.8	40.2	26.1	25.2	37.4	49.6	55.6	55.1	572.7
Effluent Irrigation	W	(Q x D) / L	mm/month	93.0	84.0	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	1095.0
Inputs		P + W	mm/month	158.5	154.6	161.3	137.3	124.8	130.2	119.1	118.2	127.4	142.6	145.6	148.1	1667.7
Outputs																
Evapotranspiration	ET	E x C	mm/month	109.74	90.72	81.84	59.40	39.06	30.60	35.34	53.94	72.00	85.56	100.80	120.90	879.90
Percolation	B	(R / 7) x D	mm/month	103.2	93.2	103.2	99.9	103.2	99.9	103.2	103.2	99.9	103.2	99.9	103.2	1214.9
Outputs		ET + B	mm/month	212.9	183.9	185.0	159.3	142.2	130.5	138.5	157.1	171.9	188.7	200.7	224.1	2094.8
Storage	S	(P + W) - (ET + B)	mm/month	-54.4	-29.3	-23.7	-22.0	-17.4	-0.3	-19.4	-38.9	-44.5	-46.1	-55.1	-76.0	-
Cumulative Storage	M		mm	0	0	0	0	0	0	0	0	0	0	0	0	-

MONTHLY WATER BALANCE USED TO DETERMINE WET WEATHER STORAGE

Design Wastewater Flow	Q	l/day	840
Design Percolation Rate	R	mm/wk	14
Land Area	L	m^2	510

Paramters	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in Month	D	-	days	31	28	31	30	31	30	31	31	30	31	30	31	365
Precipitation	P	-	mm/month	65.5	70.6	68.3	47.3	31.8	40.2	26.1	25.2	37.4	49.6	55.6	55.1	572.7
Evaporation	E	-	mm/month	182.9	151.2	136.4	99	65.1	51	58.9	89.9	120	142.6	168	201.5	1466.5
Crop Factor	C	-	-	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	-
Inputs																
Precipitation	P	-	mm/month	65.5	70.6	68.3	47.3	31.8	40.2	26.1	25.2	37.4	49.6	55.6	55.1	572.7
Effluent Irrigation	W	(Q x D) / L	mm/month	51.1	46.1	51.1	49.4	51.1	49.4	51.1	51.1	49.4	51.1	49.4	51.1	601.2
Inputs		P + W	mm/month	116.6	116.7	119.4	96.7	82.9	89.6	77.2	76.3	86.8	100.7	105.0	106.2	1173.9
Outputs																
Evapotranspiration	ET	E x C	mm/month	109.74	90.72	81.84	59.40	39.06	30.60	35.34	53.94	72.00	85.56	100.80	120.90	879.90
Percolation	B	(R / 7) x D	mm/month	62.0	56.0	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.0
Outputs		ET + B	mm/month	171.7	146.7	143.8	119.4	101.1	90.6	97.3	115.9	132.0	147.6	160.8	182.9	1609.9
Storage	S	(P + W) - (ET + B)	mm/month	-55.2	-30.0	-24.5	-22.7	-18.2	-1.0	-20.2	-39.7	-45.2	-46.9	-55.8	-76.7	-
Cumulative Storage	M		mm	0	0	0	0	0	0	0	0	0	0	0	0	-